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ABSTRACT

Primary grade pupils can become fascinated with simple machines. This paper suggests that teachers have simple machines in the classroom for a unit of study. It proposes some guidelines to create a unit of study for six simple machines that include the fulcrum, inclined plane, pulley, wheel and axle, wedge, and screw. Friction, gravity, force, and inertia are the concepts to be studied in all facets of the unit. (ASK)

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Fun with Physics in the Elementary School

by
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FUN WITH PHYSICS IN THE ELEMENTARY SCHOOL

Primary grade pupils can become fascinated with simple machines. Pupils need to develop interest in these units of study. The science teacher should use selected strategies to initiate learning opportunities in which learner interest in simple machines may be an end result. If pupils already possess these interests, then the teacher needs to maintain this level of attention of pupils. Securing the attention of pupils for ongoing learning activities and obtaining their interests are key factors in having pupils learn. I strongly recommend that the science teacher have simple machines in the classroom for this important unit of study. I have supervised student teachers and cooperating teachers over a period of thirty years whereby excellent units have been taught on simple machines. In these units of study, pupils have experienced the concrete phase of learning with the actual simple machines being there for observation and experimentation.

To begin the unit of study, I recommend that the teacher have simple machines on an interest center. Here, the science teacher may then have a lever for pupils to handle and discuss. Learners will ask questions of each other and of the teacher pertaining to the uses of the lever. A fulcrum should be located nearby to further pupil interest pertaining to the lever. A second simple machine adjacent to the interest center for pupil observation and discussion is the inclined plane. Perhaps, the inclined plane should be on the floor so that pupils might think of ways to use this simple machine. Several of my teachers whom I supervised in the public schools have had objects nearby for pupils to move up the inclined plane, such as several books attached together with a belt. These pupils might also lift the books from the floor to the table top without the use of the inclined plane. A third simple machine for pupil study is the pulley. This device brings on much pupil interest in that objects may be lifted from the floor level to the table top. The pulley has a long history of being used to lift objects that are much too heavy for individuals to lift. A fourth simple machine on/near the interest center

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should be a wheel and axle. From a coaster or bicycle, a wheel and axle may be secured with little effort. I have observed in classrooms where pupils volunteer to bring in simple machines; the wheel and axle has been a frequent object brought in by pupils or parents. It is good to have parents involved in curriculum development.

Fifth, a wedge should also be placed on the interest center. An axe then can be examined by pupils as an example of a wedge. When pupils view objects, they tend to raise questions and desire answers. Curiosity may be at its highest here.

A sixth simple machine is a screw. These are easy to obtain and have at the interest center.

The following concepts need to be used in all facets of the unit where applicable: friction, gravity, force, and inertia.

In addition to the six simple machines at the learning center, the teacher should also develop a bulletin board display showing each of the simple machines. A caption orientates pupils to the display. Each simple machine illustrated on the bulletin board should be clear and attractive with brief comments underneath each illustration.

From the objects on the interest center and the bulletin board display, learners will ask questions and make comments pertaining to any one or combination of the simple machines. From my experiences as university supervisor of student teachers and cooperating teachers, the following questions have been raised by pupils pertaining to objects and bulletin board displays on simple machines:

1. How can levers help to make work easier?
2. How are inclined planes used in society?
3. How can we use a pulley in our classroom?
4. How many different items/machines use wheels and axles?
5. How might wedges be useful objects in school and its surroundings?

Four pupils volunteered to engage in research to find answers for each problem area. Thus, for problem area one, pupils found ways to

make work easier through the use of a lever. A lever with the fulcrum was used to lift the teacher briefly. The teacher stood in a small box for purposes of being lifted by a lever. Outdoors, pupils removed a few rocks from the ground through lever use. These are first class levers in that the fulcrum is between the force-- the person applying effort, and the load-- person or stones being lifted. A second class lever emphasized a wheel barrow being used to demonstrate hauling rocks. Here, the load lies between the fulcrum and applied force.

One committee member read about the elbow being a fulcrum while the hand is used to lift a load such as a ball. The forearm supplies the upward force that lifts the ball. This is a third class lever.

Four other pupils gathered information on problem number two above, "How are inclined planes used in society?" Parents can be heavily involved in providing information. A committee member's father was in the commercial moving business. He supplied the class with numerous pictures of how furniture was moved into a truck using inclined planes. Instead of lifting furniture items from the ground into the truck, an inclined plane was used to push furniture upward in a thirty degree slope. There were pictures which showed cars driving on a ramp to be loaded onto a truck. Additional pictures indicated furniture being moved from the moving truck into the house. Here also, an inclined plane was used. It was pointed out that the ramp was quite similar to ramps in a parking garage. One pupil mentioned his father drained oil in his car by driving up a small metal inclined plane.

Four pupils gathered information on problem area number three above. It was difficult for pupils to find ways of using pulleys in the classroom. Pupils asked questions of their parents in the home setting pertaining to answers. One pupil came up with a proposal to use a pulley to lift and stack boxes to a higher level on the classroom. Another learner suggested lifting a child by hand and then make comparisons with lifting the pupil using the pulley. One child told of a school his cousin attended whereby library books were read on a classroom loft if the reader chose to do so. Here, the library books to be read could be lifted to the loft area for learner choice.

Four committee members finding uses for wheels and axles brainstormed these utilitarian purposes. The list was rather long, with homework involved here, to secure these uses. The uses listed were, among others: on cars, busses, trucks, wheel barrows, tractors, combines, grain drills, plows, disks, mowers, tricycles, bicycles, coasters, and mowers.

Committee five worked on how wedges might be useful in society. They looked around the room to notice door stops to keep doors open. From a discussion in the home setting, learners brought to class and discussed different uses for wedges. These uses included

1. splitting a log.
2. carving wood with a knife.
3. keeping a loose fitting cabinet door closed.
4. driving a nail into a piece of wood.
5. shaving wood on a door to fit a frame by using a jack plane.

Pupils wondered what would be discussed or learned about the sixth simple machine-- the screw. The teacher had shown on the interest center a wood screw as well as a metal screw and their purposes. One pupil had counted the number of wood screws contained on the classroom library door.

The teacher had borrowed from a neighbor an old jack screw which was a combination of a lever and a screw. The jack screw, as the name indicates, was a jack that could support a heavy load. The jack screw shown to pupils had been used years ago in supporting a heavy load of hay bales on the hay loft of a barn. Thus the jack screw was placed underneath a large four by ten foot joist to keep the floor of the hay loft from collapsing.

Pupils then discussed the use of a jack to lift the side of the car with a flat tire. The flat tire could then be changed.

Bringing Pictures to the Classroom

After observing and discussing six simple machines, pupils with teacher guidance volunteered to bring in pictures of simple machines.

The school had old magazines which also could be used to locate illustrations of simple machines. Each of the five committees developed a bulletin board display containing their respective simple machines discussed collaboratively. Thus, for example, the committee which worked on levers had a neat, clear caption containing pictures of each of three kinds of levers. Different uses of levers were shown such as using a crow bar to pull out nails from a piece of wood.

The committe on the inclined plane contained a caption entitled "Why use inclined planes?" One unusual picture on the bulletin board here was a cattle truck being backed up against a barn to load cattle to take to new pasture land. At the back of the truck was a very strong board, an inclined plane, on which cattle could walk upward from ground level onto the truck bed with the stock rack.

Committee number three developed a bulletin board display on modern uses of pulleys. One interesting picture pertained to a pulley being used by a mechanic in a garage to lift an old engine out of an automobile and replace it with a new one. Pupils marveled at the strength of pulleys.

Committee number four developed a bulletin board display on the history of the wheel and axle. Of particular interest to learners was an illustration on drawing water from a well showing a rope with a bucket on the end. A man was shown turning a wheel with which made for turns of the rope on the attached axle. This brought the water bucket to the surface with the needed water.

Committee number five developed a bulletin board on wedges. Pupils came up with selected interesting illustrations here, including the shim to level furniture as well as the fork used in eating.

The sixth simple machine --the screw- was discussed in the learning opportunities presented below.

Application of What Was Learned

The teacher showed examples of different simple machines for pupils to classify and give reasons for their classification (Ediger,1995). The following simple machines were analyzed:

1. the screw. A hand mixer, a grain augur to move wheat and other farm grains, the unloading augur to automatically unload feed from a silo for cattle to eat. Illustrations were shown of the last two items whereas the mixer was brought to class by the teacher.

2. lever. The teeter-totter (viewed on the playground from the classroom window), a pair of pliers, and a nutcracker. the latter two items were brought to class.

3. Inclined plane. These included the ramp located next to the school building used by handicapped individuals, an illustration of loading a riding mower going onto a trailer to be taken in for repair work, steps located in the school building, a roof on a house viewed from the classroom, and a snapshot of a ramp used for miniature car races at a Boy Scout meeting.

4. The pulley. Illustrations were shown of the many pulleys on a picture of a self propelled combine used for cutting grain. One pupil mentioned his grandfather had had chains and sprockets instead of belts and pulleys on the combine. An illustration was also shown of belts and pulleys in cars such as a belt connecting the wheel of the alternator and the water pump.

5. Wheel and axle. The pupils looked at and discussed the merry go round on the playground. A toy windmill brought to the classroom, the pencil sharpener on the wall, tinker toy sets to make wheels and axles, and toy cars to observe and discuss in the classroom were discussed.

6. Wedge. A blade on a mower, a knife, a chisel, a plane to shave wood, an illustration of a jointer to shave wood, and a drawing knife used by carpenters were analyzed.

There are numerous illustrations and objects that may be shown to pupils in order to learn about as well as review simple machines. Knowledge acquired should be used. Higher levels of cognition may be emphasized such a as critical thinking when clarity is stressed in classifying one simple machine form another (Ediger and Rao, 1996). Also, creative thinking may be stressed with pupils coming up with novel

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uses of simple machines. For example, one group brainstormed the possible uses for a wedge. the committee came up with twenty-five uses. Interesting ways were the following:

1. a decoration to be used at Christmas time with paintings contained thereon pertaining to that time of the year.
2. a material to be used in teaching mathematics to show, among other things, the face of a triangle.
3. a wedge to keep a bicycle from sliding backward.

Extending Learning Opportunities

There are numerous learning opportunities that extend and enrich pupil learning pertaining to simple machines. These include the following:

1. making a scrapbook containing illustrations of simple machines and a brief description of each.
2. developing a collection of pictures which pertain to simple machines.
3. doing a mural on one or more simple machines.
4. constructing model simple machines.
5. reading library books on simple machines.
6. making dioramas.
7. developing a movie set on simple machines.
8. being on the lookout and recording names of simple machines found in the school and schoolgrounds.
9. giving oral reports to a committee or class as a whole on simple machines.
10. viewing and discussing audiovisual aids on simple machines.
11. performing experiments with simple machines.
12. using technology to obtain information such as CD ROMS with their printed content and illustrations on simple machines.
13. obtaining information from software on simple machines.
14. dramatizing using of each simple machine.
15. conducting a seminar on simple machines.

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In Closing

The teacher needs to obtain the interests of pupils in a unit on simple machines. Background information is needed to provide readiness for the new unit to be studied. The learner then has an improved opportunity to understand content in the unit to be pursued. Meaningful learning activities is important to the learner. Pupils need to perceive reasons for studying simple machines. The science teacher has an important responsibility in guiding pupils to accept reasons for study and reflection. Each pupil is unique and has content which helshe would wish to pursue. Intrinsic motivation is important to stress here. From within, the pupil is motivated to achieve and develop. Adequate attention needs to be paid to the learner's goals and objectives. Problem solving needs adequate emphasis in ongoing lessons and units of study. Along with problem solving is critical thinking whereby the involved pupil learns to assess the quality of information gathered in problem solving. Also, creative thinking is needed in which the pupil comes up with original responses to problematic situations. The pupil also thinks of unique ways of acquiring content in order to solve the problem.

Learners need to develop more fully in succeeding units of study stressing simple and complex machines. With quality sequence, the learner may experience increasingly challenging subject matter on simple machines. This unit is a beginning in having pupils understand the uses of simple machines. Learnings should be sequential and ongoing. There is no end to what can be learned on any topic. Lifelong learning for each person is to be encouraged. With new knowledge forthcoming, the pupil needs to be curious and possess a desire to increase knowledge, skills, and attitudes in each unit of study.

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